

CLAIMS

What is claimed is:

- 1 1. An injector for distributing liquid sprays, comprising:
2 an inlet fitting including a port to receive liquid,
3 a stem assembly supported by the fitting, the stem assembly including an internal
4 circuit fluidly connected to the port, and
5 a manifold supported by the stem assembly and including an internal passage
6 connected to the internal circuit in the stem assembly, the manifold including an
7 elongated manifold segment formed of multiple plates and having a plurality of nozzles
8 spaced along the manifold segment, wherein each of the nozzles is fluidly connected to
9 the internal passage for delivering sprays of liquid.
- 1 2. The injector as in claim 1, wherein the nozzles are spaced apart in a linear array
2 along the length of the manifold segment.
- 1 3. The injector as in claim 2, wherein the nozzles are spaced apart evenly.
- 1 4. The injector as in claim 3, wherein the nozzles are located along a median line of
2 the manifold segment.
- 1 5. The injector as in claim 1, wherein the manifold segment has a planar surface and
2 the nozzles are spaced along the surface for spraying liquid outwardly from the surface.
- 1 6. The injector as in claim 1, wherein each nozzle includes a swirl chamber formed
2 in at least one of the plates having a shape such that liquid to be sprayed can move therein
3 in a vortex motion toward the center of the swirl chamber, at least one non-radial feed
4 slot intersecting the swirl chamber for directing liquid to the swirl chamber, a spray
5 orifice at the center of the swirl chamber such that liquid to be sprayed can move from

6 the swirl chamber to the spray orifice and then exit the spray orifice in a thin film which
7 soon atomizes into a fine droplet mist.

1 7. The injector as in claim 6, wherein each nozzle further includes an air swirler
2 assembly having a cylindrical air swirler passage located in co-axial relation to the spray
3 orifice of the nozzle such that liquid directed through each spray orifice passes through an
4 air swirler passage and swirling air can be imparted to the liquid to cause the liquid to
5 have a swirling component of motion; at least one air feed slot in fluid communication
6 with each air swirler passage and extending in non-radial relation thereto for supplying
7 air to be swirled in the air swirler passage; and an air supply passage which feeds the at
8 least one air feed slot.

1 8. The injector as in claim 7, wherein a pair of air supply passages are provided
2 along each manifold segment, on either side of the linear array of nozzles, each of which
3 feeds the air feed slots for the air swirler passage.

1 9. The injector as in claim 1, wherein an extension interconnects the manifold and
2 the stem assembly, the extension including an internal passage fluidly connecting the
3 internal circuit in the stem assembly with the internal passage in the manifold.

1 10. The injector as in claim 9, wherein the manifold segment includes i) a fuel
2 distribution assembly formed of multiple plates and including a swirl chamber with a
3 spray orifice in the center of the swirl chamber for directing a spray of liquid from the
4 swirl chamber, the fuel distribution assembly supported by a distribution plate connected
5 to the extension, wherein the internal passage in the manifold is located in the distribution
6 plate, and ii) an air swirler assembly formed of multiple plates stacked in surface-to-
7 surface relation with one another, and providing an air swirler passage to introduce
8 swirling air to the liquid such that the liquid spray has a swirling component of motion.

1 11. A fuel injector for a gas turbine engine, comprising:
2 an inlet fitting including a port to receive fuel,
3 a stem supported by the inlet fitting, the stem including an internal fuel circuit
4 fluidly connected to the fuel port, and
5 a manifold supported by the stem, said manifold including an internal fuel
6 passage fluidly connected to the internal fuel circuit in the stem, the manifold including
7 an elongated manifold segment having a plurality of nozzles spaced along the manifold
8 segment, wherein each of the nozzles includes i) a spray orifice fluidly connected to the
9 internal fuel passage for delivering a spray of fuel; and ii) an air swirler assembly having
10 a cylindrical air swirler passage located in co-axial relation to the spray orifice such that
11 fuel directed through the spray orifice passes through the air swirler passage and swirling
12 air can be imparted to the fuel to cause the fuel to have a swirling component of motion,
13 at least one air feed slot in fluid communication with the air swirler passage and
14 extending in non-radial relation thereto for supplying air to be swirled in the air swirler
15 passage, and an air supply passage which feeds the at least one air feed slot in the air
16 swirler passage.

1 12. The fuel injector as in claim 11, wherein the manifold segments are each formed
2 of multiple plates.

1 13. The fuel injector as in claim 11, wherein the nozzles are spaced apart in a linear
2 array along the length of the manifold segment.

1 14. The fuel injector as in claim 13, wherein wherein the nozzles are spaced apart
2 evenly.

1 15. The injector as in claim 3, wherein the nozzles are located along a median line of
2 the manifold segment.

1 16. The fuel injector as in claim 15, wherein a pair of air supply passages are
2 provided along each manifold segment, on either side of the linear array of nozzles, and
3 each of which feeds the air feed slots for the air swirler passage.

1 17. The fuel injector as in claim 11, wherein the manifold segment has a planar
2 surface and the nozzles are spaced along the planar surface for spraying fuel outwardly
3 from the surface.

1 18. The fuel injector as in claim 11, wherein each nozzle includes a bowl-shaped
2 swirl chamber, and the spray nozzle is located at the center of the swirl chamber, such
3 that fuel to be sprayed can move therein in a vortex motion toward the center of the swirl
4 chamber and exit the spray orifice in a thin film which soon atomizes into a fine droplet
5 mist, said at least one non-radial feed slot intersecting the swirl chamber for directing fuel
6 to the swirl chamber.

1 19. A fuel injector for a gas turbine engine, comprising:
2 an inlet fitting including first and second ports, each of which receive fuel,
3 a stem supported by the fitting, the stem including first and second internal fuel
4 circuits fluidly connected to a respective port, and
5 a manifold supported by the stem, said manifold including a plurality of
6 elongated, planar manifold segments, each of which includes an internal fuel passage
7 fluidly connected to a respective internal fuel circuit in the feed stem, and each of which
8 includes a plurality of nozzles spaced along the manifold segment, wherein each of the
9 nozzles is fluidly connected to the internal passage in the respective manifold segment for
10 delivering sprays of fuel.

1 20. The fuel injector as in claim 19, wherein the nozzles are evenly spaced apart in a
2 linear array along the length of each manifold segment.

1 21. The fuel injector as in claim 20, wherein a pair of manifold segments are located
2 in adjacent relation to one another, and are supported at an angle to one another, such that
3 that the sprays of fuel from a linear array of nozzles in one manifold segment are
4 provided in a first direction, and the sprays of fuel from a linear array of nozzles in the
5 other manifold segment are provided in another direction, at an angle to the first
6 direction.

1 22. The fuel injector as in claim 21, wherein the pair of manifold segments are
2 supported at a forty five degree angle with respect to each other.

1 23. The fuel injector as in claim 19, further including a plurality of extensions
2 interposed between the stem and respective manifold segments, and fluidly
3 interconnecting a respective internal fuel circuit in the stem and an internal passage in the
4 manifold segment.

1 24. The fuel injector as in claim 23, wherein the extensions are located at distinct
2 axial locations along the stem.

1 25. The fuel injector as in claim 19, wherein each nozzle includes i) a spray orifice
2 fluidly connected to the internal fuel passage for delivering a spray of fuel; and ii) an air
3 swirler assembly having a cylindrical air swirler passage located in co-axial relation to
4 the spray orifice such that fuel directed through the spray orifice passes through the air
5 swirler passage and swirling air can be imparted to the fuel to cause the fuel to have a
6 swirling component of motion, at least one air feed slot in fluid communication with the
7 air swirler passage and extending in non-radial relation thereto for supplying air to be
8 swirled in the air swirler passage, and an air supply passage which feeds the at least one
9 air feed slot in the air swirler passage.

1 26. The fuel injector as in claim 19, wherein the manifold segments are each formed
2 of multiple plates.

1 27. A fuel injector for a gas turbine engine, comprising:
2 an inlet fitting including port means for receiving fuel,
3 a stem assembly supported by the fitting, the stem assembly including internal
4 fuel circuit means fluidly connected to the port means, and
5 a manifold supported by the stem assembly, the manifold including a plurality of
6 manifold segments, each of which includes an internal passage fluidly connected to the
7 internal fuel circuit means in the stem assembly, each manifold segment including at least
8 one nozzle, wherein a nozzle is fluidly connected to the respective internal passage for
9 delivering a spray of fuel, and wherein each of the manifold segments is supported at an
10 angle to an adjacent manifold segment, such that that the spray of fuel from one manifold
11 segment is provided in one direction, and the spray of fuel from an adjacent manifold
12 segment is provided in another direction, at an angle to the spray from the one manifold
13 segment.

1 28. The fuel injector as in claim 27, wherein the nozzle further includes an air swirler
2 assembly including a cylindrical air swirler passage located in surrounding relation to the
3 fuel spray such that the spray of fuel passes through the air swirler passage and swirling
4 air can be imparted to the fuel to cause the fuel to have a swirling component of motion;
5 at least one air feed slot in fluid communication with each air swirler passage and
6 extending in non-radial relation thereto for supplying air to be swirled in the air swirler
7 passage; and an air supply passage which feeds the at least one air feed slot.

1 29. The fuel injector as in claim 27, wherein the manifold segments are planar.

1 30. The fuel injector as in claim 27, wherein each manifold segment is elongated, and
2 a plurality of nozzles are located in an array along each manifold segment.

1 31. The fuel injector as in claim 30, wherein each manifold segment is formed of
2 multiple plates.

1 32. A fuel injector for a gas turbine engine, the engine including a bulkhead having
2 adjacent wall segments located at angles to one another, with each wall segment
3 including an injector opening, the fuel injector comprising:

4 an injector mount adapted to be fixed to the bulkhead;

5 an inlet fitting including an outer stem extending outwardly from said injector
6 mount and port means for receiving fuel;

7 an inner stem extending inwardly from the injector mount and dimensioned to be
8 received through the injector opening, the inner and outer stem including internal fuel
9 circuit means fluidly connected to the port means; and

10 a manifold supported by the inner stem, the manifold including a plurality of
11 planar manifold segments, each of which includes an internal passage fluidly connected
12 the internal fuel circuit means in the inner and outer stems, each manifold segment
13 including a plurality of nozzles, wherein the nozzles are fluidly connected to a respective
14 internal passage for delivering a spray of fuel, and wherein each of the manifold
15 segments is supported at an angle to an adjacent manifold segment, such that that the
16 sprays of fuel from one manifold segment are provided in one direction, and the sprays of
17 fuel from another manifold segment are provided in another direction, at an angle to the
18 spray from the one manifold segment.

1 33. The fuel injector as in claim 32, wherein each nozzle includes an air swirler
2 assembly including a cylindrical air swirler passage located in co-axial relation to each
3 fuel spray from the nozzle such that the fuel spray from each nozzle passes through an air
4 swirler passage and swirling air can be imparted to the fuel to cause the fuel to have a
5 swirling component of motion; at least one air feed slot in fluid communication with each
6 air swirler passage and extending in non-radial relation thereto for supplying air to be

7 swirled in the air swirler passage; and an air supply passage which feeds the at least one
8 air feed slot.

1 34. The fuel injector as in claim 32, wherein the nozzles are arranged in a linear array
2 along each manifold segment.

1 35. The fuel injector as in claim 32, wherein each manifold segment is formed of
2 multiple plates.

1 36. The fuel injector as in claim 32, wherein the manifold segments are elongated.

1 37. A fuel injector for a gas turbine engine, comprising:
2 an inlet fitting including first and second ports, each of which receives fuel,
3 a stem supported by the fitting, the stem including first and second internal fuel
4 conduits fluidly connected to a respective port, and
5 a manifold supported by the stem, the manifold including a set of three elongated,
6 planar, adjacent manifold segments, each of which includes an internal passage fluidly
7 connected to a respective internal fuel circuit in the stem, with a first of the manifold
8 segments fluidly connected to one of the internal fuel circuits, and the other two of the
9 manifold segments fluidly connected to the other of the internal fuel circuits, each of the
10 manifold segments supporting a plurality of nozzles in a linear array along the manifold
11 segment, wherein each of the manifold segments includes multiple layers, and each
12 nozzle is comprised of at least one of the layers and is fluidly connected to a respective
13 internal passage for delivering a spray of fuel, and wherein the first of the manifold
14 segments is located intermediate the other two of the manifold segments, with the other
15 two of the manifold segments supported at angles to the first manifold segment, such that
16 the sprays of fuel from the nozzles of the first manifold segment are provided in one
17 direction, and the sprays of fuel from the nozzles in the other manifold segments are
18 provided in other directions, away from the first sprays, and wherein each nozzle further

19 includes a multilayered air swirler assembly including a cylindrical air swirler passage
20 located in co-axial relation to the sprays of fuel and at least one air feed slot in fluid
21 communication with the air swirler passage and extending in non-radial relation thereto
22 for supplying air to be swirled in the air swirler passage, such that fuel sprays each pass
23 through an air swirler passage and swirling air can be imparted to the fuel to cause the
24 fuel to have a swirling component of motion.